complex. Conversely, attaching a multiplicity of magnetic particles to a cell enhances the overall magnetization associated with the cell. The total magnetization of the labeled target in a magnetic field will thus depend on the individual magnetic moment of the particles, the size (volume) of the resulting labeled complex, and the number of magnetized particles per labeled complex.

[0109] In a preferred embodiment, more than one analytes in the sample are labeled in the labeling chamber. The different analytes can be labeled in a single labeling reaction, or, more preferably, in separate reactions or even separate labeling chambers.

[0110] In a preferred embodiment, the microfluidic device comprises a releasing chamber in which a target analyte that was attached to a magnetic label can be released from the label after being processed in the magnetic microchannel. The releasing chamber may contain the necessary reagents, or they may be stored in a storage module and pumped as needed.

[0111] In a preferred embodiment, the releasing reaction comprises a change in pH, salt concentration, temperature, etc.

[0112] In a preferred embodiment, the releasing reaction comprises an addition of competing ligands, detergents, chaotropic agents, organic compounds, or solvents, etc.

[0113] As will be appreciated by those in the art, the labeling chamber and the releasing chamber can be separate chambers that are dedicated to the labeling and releasing reactions. Alternatively, they can be part of the reaction module or other modules as described below. In addition, the releasing reaction described above can also be carried out in the magnetic microchannel.

[0114] As will be appreciated by those in the art and outlined below, the labeling chamber, the magnetic microchannel, and the releasing chamber can be integrated into the microfluidic devices of the invention in a wide variety of configurations. Specifically, a labeling chamber can be positioned anywhere before a magnetic microchannel, and a releasing chamber can be positioned anywhere in or after a magnetic microchannel.

[0115] In addition to the magnetic processing system, the devices of the invention are configured to include one or more of a variety of components, herein referred to as "modules", that will be present on any given device depending on its use. These modules include, but are not limited to: sample inlet or outlet ports; sample introduction or collection modules; cell handling modules (for example, for cell lysis, cell removal, cell concentration, cell separation or capture, cell growth, etc.); separation modules, for example, for electrophoresis, dielectrophoresis, gel filtration, ion exchange/affinity chromatography etc.; reaction modules for chemical or biological alteration of the sample, including amplification of the target analyte (for example, when the target analyte is nucleic acid, amplification techniques are useful, including, but not limited to polymerase chain reaction (PCR), ligase chain reaction (LCR), strand displacement amplification (SDA), and nucleic acid sequence based amplification (NASBA)), chemical, physical or enzymatic cleavage or alteration of the target analyte, or chemical modification of the target; fluid pumps; fluid valves; thermal modules for heating and cooling; storage modules for assay reagents; mixing chambers; and detection modules.

[0116] In a preferred embodiment, the microfluidic devices of the invention comprise at least one sample inlet port for the introduction of the sample to the device. This may be part of or separate from a cell handling module, a reaction module, or a labeling chamber, that is, the sample may be directly fed in from the sample inlet port to the magnetic microchannel, or it may be pre-processed in other modules and transferred into the magnetic microchannel through a sample inlet port. Where there is only a single inlet, the inlet must serve to both admit samples to the magnetic microchannel and to admit solutions such as washing and elution solutions that pass through the magnetic channels. More preferably, one or more fluid inlets in addition to the sample inlet port are provided.

[0117] In a preferred embodiment, the microfluidic devices of the invention comprise at least one sample outlet port. By "sample outlet" port herein is meant the outlet port where the samples processed in the magnetic microchannel flow through. In addition, outlet ports for other microchannel of the invention are provided. The sample outlet port can be directly linked to a subsequent module (e.g., a reaction module, a separation module, or a detection module), or alternatively the sample can be collected from the outlet port and further processed. Where there is a single outlet port, the outlet port must serve both to discharge the flow-through portion of the sample that is not retained by the magnetic microchannel and to pass the portion that is bound to and subsequently eluted from the channel to subsequent processes. More preferably, there is at least one disposal outlet that is separate from the sample outlet port so that the flow-through sample can be disposed quickly without being mixed with the retained portion of the sample.

[0118] In a preferred embodiment, at least one sample outlet port or disposal outlet port is connected to a sample inlet port so that the samples can go through several rounds of processing either by the same magnetic microchannel or through additional channels in a multiple-channel arrangement in the same device or multiple devices. These multiple channels can either be of the same design or of various designs.

[0119] In a preferred embodiment, the devices of the invention include a sample collection module, which can be used to concentrate or enrich the sample if required; for example, see U.S. Pat. No. 5,770,029, including the discussion of enrichment channels and enrichment means.

[0120] In a preferred embodiment, the devices of the invention include a cell handling module. This is of particular use when the sample comprises cells that either contain the target analyte or that must be removed in order to detect the target analyte. Thus, for example, the detection of particular antibodies in blood can require the removal of the blood cells for efficient analysis, or the cells (and/or nucleus) must be lysed prior to detection. In this context, "cells" include eukaryotic and prokaryotic cells, and viral particles that may require treatment prior to analysis, such as the release of nucleic acid from a viral particle prior to detection of target sequences. In addition, cell handling modules may also utilize a downstream means for determining the presence or absence of cells. Suitable cell handling modules include, but are not limited to, cell lysis modules, cell